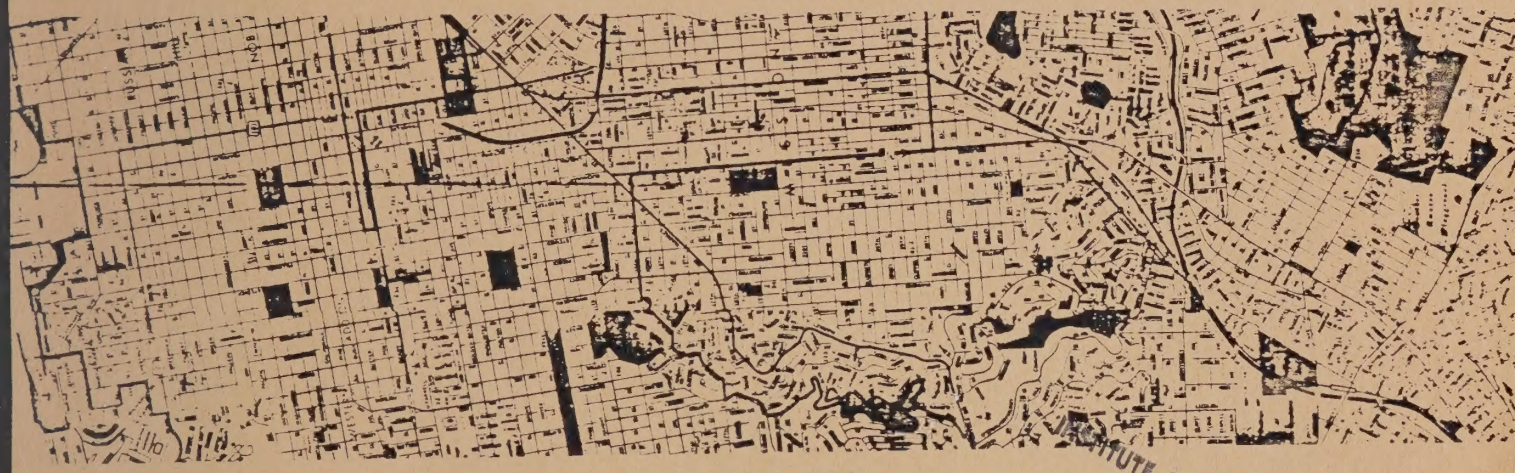
A FEASIBILITY REVIEW OF THE WASTE DISPOSAL CONCEPT IN "PROGRESS REPORT NO. 1 - CONCEPTUAL DESIGN STUDY - SAN FRANCISCO RESOURCE CONVERSION CENTER"



PREPARED FOR

THE CITY AND COUNTY OF SAN FRANCISCO

AUGUST, 1979

A FEASIBILITY REVIEW OF THE WASTE DISPOSAL CONCEPT IN

"PROGRESS REPORT No. 1 - CONCEPTUAL DESIGN STUDY - SAN FRANCISCO RESOURCE CONVERSION CENTER"

CSI RESOURCE SYSTEMS, INC.

CSI RESOURCE SYSTEMS, INC.

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INTRODUCTION

The City and County of San Francisco is facing a serious solid waste disposal problem. The City's contract for disposing of its solid waste in Mountain View expires in 1983. Consequently, the City must act expeditiously to develop a replacement for the current land disposal system. The new system could include a resource recovery plant and a landfill for disposal of residues and ash, or could simply include one or more new landfills for the disposal of unprocessed solid waste. In either case, source separation and other recycling programs could reduce the amount of material for land disposal.

In September 1978, the City received "Progress Report No. 1; Conceptual Design Study: "San Francisco Resource Conversion Center." The report was submitted to the City by Sanitary Fill Company, a joint-venture of Sunset Scavengers and Golden Gate Disposal Company. The report presents the results of several years of cooperative effort among Sanitary Fill Company, the City, and Pacific Gas & Electric to develop an environmentally superior alternative to the landfilling of the City's solid waste, and to avert a waste disposal crisis in the mid-1980's.

Sanitary Fill Company proposed a 1900 ton per day resource recovery facility for processing the solid waste currently being handled at the transfer station in Brisbane. The proposed facility would separate metals and other heavy materials from the waste, and use the recovered combustible fraction as fuel in a steam power plant to generate electricity. The system would substantially reduce the amount of material for landfilling while recovering otherwise wasted energy and metals.

In February 1979, Roger Boas, the City's Chief Administrative Officer, retained CSI Resource Systems, Inc. (Resource Systems) to review the Sanitary Fill Company report.* The purpose of the Resource

*Resource Systems was assisted in this effort by its land disposal subcontractor, SCS Engineers; and by Smith Barney, Harris Upham & Co., Inc., who provided advice on project financing issues.

Systems' effort was to perform an independent review and evaluation and to make recommendations to the City on how to proceed. The technical evaluation included assessing the performance of the proposed solid waste disposal system and estimating overall project economics. The evaluation also included identifying and comparing several potentially feasible alternatives with the Sanitary Fill Company proposal. Resource Systems focused on four key questions:

- *What is the likely performance of a resource recovery system of the Sanitary Fill Company design?*
- *What are the costs and overall economics of the Sanitary Fill Company project, and how do these economics compare to reasonable resource recovery and land disposal alternatives?*
- *How long will it take to implement the project proposed by Sanitary Fill Company?*
- *How should the City proceed to implement a resource recovery project which serves and protects the needs and interests of the ratepayers?*

ANALYTIC APPROACH

A resource recovery facility has two functions...to dispose of solid waste, and to produce energy and materials for sale in the marketplace. Thus, a resource recovery project serves the public purposes of waste disposal and energy and materials conservation, and the business purpose of production and sale of valuable products. Consequently, the process of implementing a resource recovery project must be sensitive to the needs of the public for reliable, economic, and environmentally sound disposal of solid waste, and to the demands on the private partner to run a profitable manufacturing business.

A successful resource recovery project has seven key ingredients:

- An *energy buyer* who is willing and able to enter into a long-term agreement to purchase energy.
- A reliable *supply of solid waste*...the feedstock to a resource recovery plant.
- A *technology* which can safely, efficiently, and reliably convert the waste into a saleable form of energy in the quantities and of the quality required by the buyer.
- *Revenue streams* which are sufficient to cover operating and maintenance costs, debt service, and operator profits.
- Overall *project economics* which are competitive with alternative means of waste disposal.
- Public and private *partners* who are willing and able to assume responsibilities for the project risks which are in their respective domains, and for performance of their respective functions in the project (e.g., assurance of waste supply and payment of disposal fees, assurance of facility performance and cost, and assurance of energy purchase).
- *Procurement, financing, and project implementation approaches* which meet the requirements of existing laws and regulations, and which are consistent with the risk postures and risk management capabilities of the partners in the project.

The Resource Systems approach to evaluating the Sanitary Fill Company proposal was to determine if the key ingredients to a successful project exist, and if the needs and interests of the public and private partners in the project can be well-served by the proposed implementation scheme. Accordingly, Resource Systems' efforts included:

- Review of feasibility study work conducted over the last several years by Sanitary Fill Company.
- Review of design documents and data.*
- Review of waste quantity and composition data.
- Evaluation of markets for energy and recovered metals.
- Assessment of landfill site availability and land disposal costs.
- Identification of alternative resource recovery systems and development of their performance characteristics, including preliminary mass and energy balances.
- Review of alternative methods for the coprocessing of solid waste and sewage sludge.
- Evaluation of the economics of the alternative resource recovery systems, including comparison of estimated capital cost, O&M costs, and debt service.
- Evaluation of the environmental characteristics of the alternative resource recovery systems.
- Estimation of the time required to implement each of the alternative resource recovery systems.
- Review of project financing alternatives and requirements.

*At the time of Resource Systems' review of the Sanitary Fill Company proposal, the preliminary designs for the recovery facility were not available. Consequently, the findings reported in this report are based on the conceptual design presented in their progress report, discussions with Sanitary Fill Company personnel and subcontractors, engineering judgements, and data from the testing of developmental and operating resource recovery systems.

- Review of the key legal authorities and requirements for project implementation.

- Identification of major project risks and definition of alternative methods for allocating and/or sharing the risks.

The 1900 TPD (tons per day) facility proposed by Sanitary Fill Company will include front-end processing (shredding, screening, and air classification) of the incoming solid waste to produce a fuel product, magnetic metals, a mix of non-magnetic metals, and residue for disposal. The fuel will be fired in boilers to produce steam. The steam will be used to produce electricity for sale to Pacific Gas & Electric or the California Department of Water Resources. The recovered metals will be sold to secondary materials reprocessors. By-passed waste and system residues will be landfilled. Figure 1 illustrates the Sanitary Fill Company System.

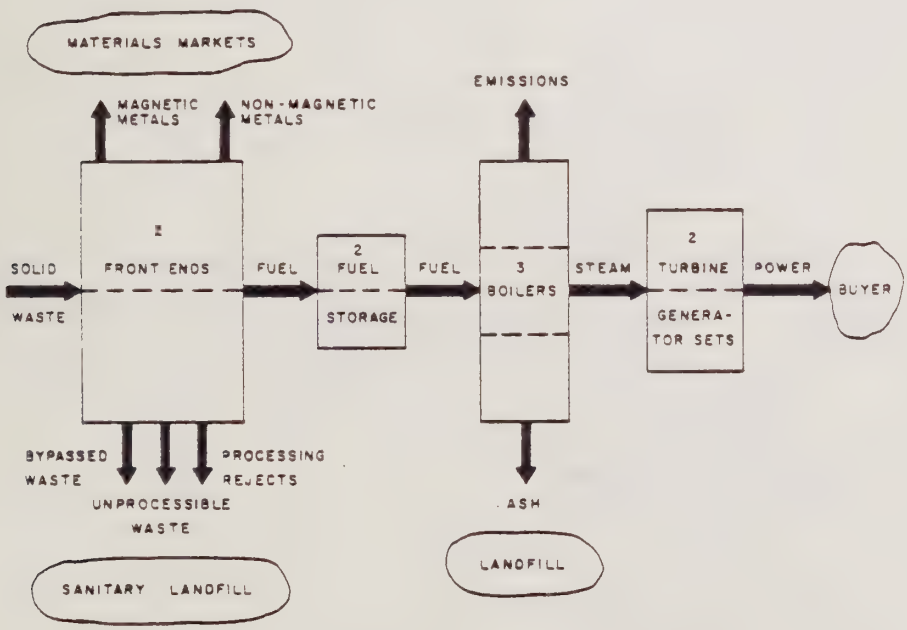


Figure 1. Sanitary Fill Company System.

For the purpose of comparison, Resource Systems chose four alternatives to the Sanitary Fill Company design. The alternatives included:

- The Sanitary Fill Company design without the second steam turbine generator. Figure 1, without the redundant steam turbine generator, illustrates this alternative system.

- Fuel preparation at a Brisbane plant, with rail transport of the fuel to remote boilers which produce steam for sale to industry. This alternative is referred to as the "Split System"; the boiler facility is assumed to be located in the Pittsburg/Antioch area. This alternative employs the same technology as has been proposed by Sanitary Fill Company. However, location of the boilers outside of the Bay Area could make it considerably easier to obtain the air permits necessary for construction and operation of the facility. Figure 2 illustrates the Split System.

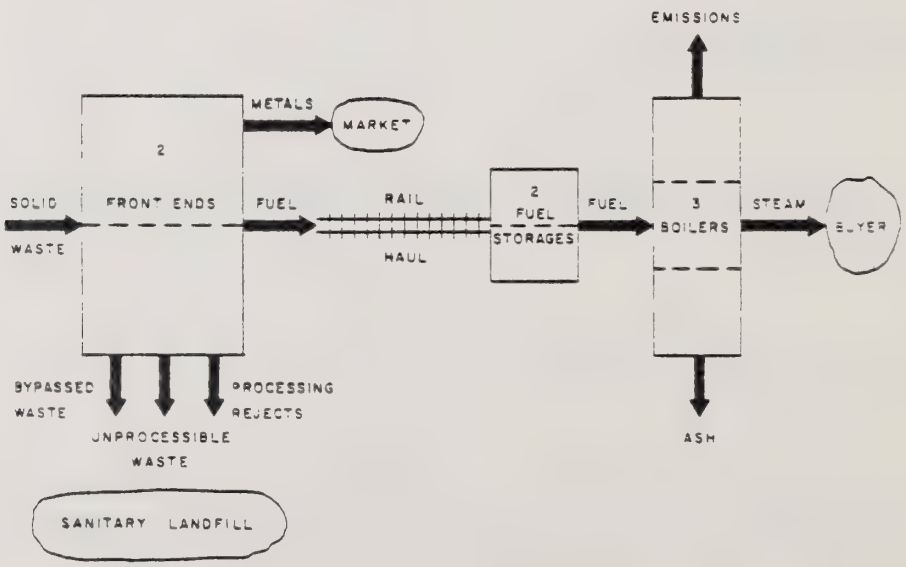


Figure 2. Split System.

- Massburning of unprocessed waste at Brisbane to produce steam and electricity. This alternative includes no front-end processing of the incoming waste, and is considered the most proven energy recovery technology available. However, massburning systems produce considerable amounts of ash, much of which is the metals and glass contained in the incoming waste. Figure 3 illustrates the Massburning Waterwall System.

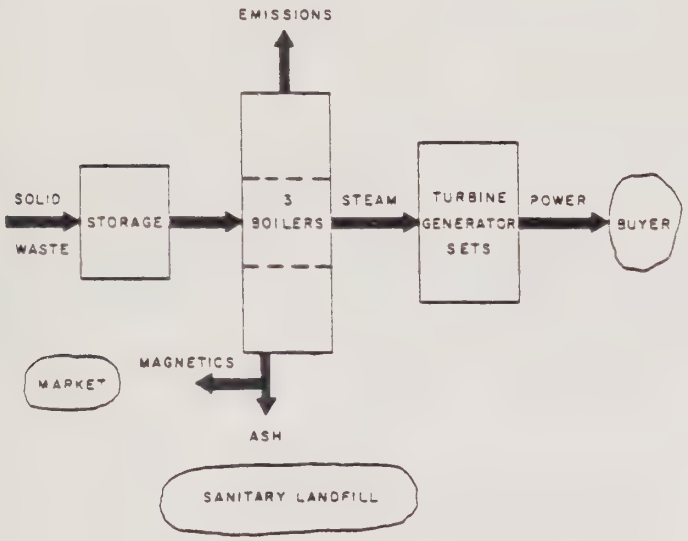


Figure 3. Massburning Waterwall System.

The final alternative was:

- Landfilling of the solid waste, either in existing landfills or at a new site acquired by the City.

CONCLUSIONS AND RECOMMENDATIONS

Results of Resource Systems' evaluation of the Sanitary Fill Company proposal, the resource recovery alternatives, and the land disposal alternative lead to several conclusions and recommendations...

CONCLUSION: Sanitary Fill Company's proposed project is technically feasible--

The Sanitary Fill Company design is likely to produce a fuel suitable for firing in the proposed boilers. The proposed boilers and turbine generators will convert the solid fuel into steam and electricity. However, many of the Sanitary Fill Company estimates of system performance appear to be optimistic. The design for the front-end processing system could be simplified to reduce maintenance costs and/or potential start-up and operation problems.

RECOMMENDATIONS: The Sanitary Fill Company system design can and should be simplified. Preliminary design drawings and updated system performance data should be reviewed by the City to determine realistic performance expectations and requirements.

* * *

CONCLUSION: Long-term project economics are likely to be competitive with landfill costs--

Resource Systems estimates that by 1984 the total cost for land disposal of the City's solid waste will be anywhere from $22 to $30 per ton. Analyses of the economics of the proposed Sanitary Fill Company system, modified to incorporate only one electrical generator, indicate comparable net disposal costs. If boiler ash can be disposed of in a sanitary landfill, net disposal costs for resource recovery could be less than the cost for

land disposal.* The proposed project appears to be economically feasible even after adjusting upwards Sanitary Fill Company's estimates of construction and start-up time, and capital, financing, and operating and maintenance costs.

RECOMMENDATIONS: It makes economic sense for the City to proceed with the implementation of the proposed resource recovery concept. However, the redundant turbine generator should be eliminated, system costs should be updated on the basis of preliminary design drawings, and project economics should be updated once a firmer price for electricity is established. Furthermore, the City should take steps to resolve the issue of hazardous waste classification of boiler ash.

* * *

CONCLUSION: It is unlikely that a resource recovery facility will be operational by the time the City's contract with Mountain View expires--

Resource Systems' analyses indicate that, under the best of circumstances, a resource recovery plant could not be fully operational in San Francisco until mid to late 1984. This estimate provides for completion of the environmental review and air pollution permitting processes before project financing can occur and, therefore, before initiation of final design and construction in mid 1980. Approximately forty-eight months have been allowed for design, construction, and start-up activities...this is consistent with experience on other large-scale resource recovery projects.

*Current California regulations appear to require the disposal of incinerator ash in a hazardous waste landfill. This regulation needs to be reviewed and may be revised based on better environmental information. If not changed, the regulation could add $6 per ton to the net disposal cost at a resource recovery facility of the Sanitary Fill Company design.

RECOMMENDATION: The City should initiate a program to acquire landfill space for: (1) disposing of solid waste during the period between termination of the Mountain View contract and initiation of commercial operations at a resource recovery facility; (2) disposing of by-passed waste, process residues, and ash once the recovery facility is operational; and (3) backup for the resource recovery facility.

* * *

CONCLUSION: The potential classification of boiler ash as a hazardous waste reduces the economic competitiveness of massburning waterwall systems--

Resource Systems' economic analyses indicate that massburning waterwall systems, which do not include front-end processing to remove metals and glass prior to combustion, may not be economically competitive if boiler ash is considered a hazardous waste. This is because massburners produce more than twice as much ash as a system of the Sanitary Fill Company design, and because hazardous waste disposal costs are very high.

RECOMMENDATION: The City should require either: (1) front-end processing of solid waste to remove materials prior to combustion, thereby reducing the amount of ash for disposal; or (2) back-end processing of boiler ash to remove saleable materials, and development of firm markets for these materials, so that the amount of ash for disposal is reduced to a level comparable to systems with front-end processing.

* * *

CONCLUSION: Completion of the environmental impact review and securing of air permits are major implementation uncertainties and cost determinants--

One difficult aspect of resource recovery project implementation in the Bay Area is completing environmental review processes and permit requirements. The proposed Sanitary Fill Company facility could be, on balance, environmentally superior to land disposal of solid waste. However, Resource Systems' estimates of emissions indicate that although the proposed facility should be able to meet New Source Performance Standards for the regulated emissions, operation of the facility in the southern Bay Area (a Federal Primary Air Quality Standards non-attainment area) may make it necessary to secure emissions offsets or secure exemptions from existing offset requirements. In recognition of the overall desirability of resource recovery, Federal regulations both permit and encourage air pollution control agencies to exempt resource recovery plants from emissions offsets. However, to date, State and regional air quality agencies in California have not adopted the Federal policy.

The environmental review and permitting processes are time-consuming. Therefore, they have major impacts on project costs (through inflating equipment and construction costs*). Thus, additional delays caused by the potential need to secure offsets or exemptions will have adverse impacts on project economics.

RECOMMENDATION: The City should take steps to help expedite the environmental review process, and should support efforts to secure air pollution offsets and/or exemptions from offset requirements.

* * *

*The capital cost of a $100 million facility may escalate as much as $12 million per year. Thus, every year of delay results in an annualized cost of approximately $1 million, or about $2 per ton of waste processed in a typical 2000 TPD plant.

CONCLUSION: Electricity is the best energy product for a recovery facility serving the City--

Both Pacific Gas & Electric and the California Department of Water Resources are willing electricity buyers.* Preliminary investigations of energy markets in the Bay Area failed to identify any potential for using refuse-derived fuel as an auxiliary fuel in existing boilers. The most attractive potential steam markets are in the Pittsburg and Antioch areas. These markets are too far away from the Brisbane site to economically justify the shipment of fuel and the construction and operation of a remote boiler installation.

RECOMMENDATION: The principles of an arrangement with an electricity buyer should be defined, and negotiations with Pacific Gas & Electric, and with the Department of Water Resources should be initiated.

* * *

CONCLUSION: It may be feasible to dispose of the City's sewage sludge in the proposed resource recovery plant--

Several techniques exist for the coprocessing of sewage sludge and solid waste. It is possible that the Sanitary Fill Company system design can be adapted to accept the 100 TPD (dry weight) of City sewage sludge for combustion with refuse-derived fuel in the boilers. However, the impact of cocombustion on system cost, project schedule, system reliability, and energy production is currently unknown.

RECOMMENDATION: The feasibility of cocombustion of sewage sludge and refuse-derived fuel in boilers of the type proposed by Sanitary Fill Company should be evaluated. Based on the results of this evaluation, the City might consider making provisions at the resource recovery site for sludge receiving, drying, and processing equipment. The final design of the resource

* Pacific Gas & Electric may also be willing to purchase steam for electricity production from new generators it builds and operates.

recovery facility should anticipate these additions. Progress on the resource recovery project should not, however, be slowed down because of the codisposal opportunity.

* * *

CONCLUSION: System procurement and project financing require clarification of legal and institutional requirements--

The City has been asked to approve Sanitary Fill Company's plan to design, construct, operate, and (nominally) own the proposed resource recovery facility. The anticipated revenue bond project financing will likely require that the Rate Board and/or the Board of Supervisors enter into agreements (or pass binding resolutions): (1) which designate the facility as the sole disposal site for solid waste generated within the City; and (2) which guarantee that collection and disposal rates will be maintained at a level sufficient to cover debt service on the bonds and facility operating and maintenance costs. The legal procedures for establishing such agreements have not been developed. Consequently, a project financing plan cannot be prepared.

RECOMMENDATIONS: Formal legal opinions on procurement requirements and on City covenants in support of a project financing should be obtained. A preliminary project financing plan should be developed.

* * *

CONCLUSION: Although the proposed resource recovery project appears to be technically and economically feasible, the performance and economics of the recovery system are uncertain--

Experience with even the most proven resource recovery technologies (massburning waterwall units which burn unprocessed solid waste and produce steam)

indicates that system performance and cost cannot be accurately predicted. The few operating resource recovery plants in this country provide ample evidence of the difficulties associated with starting-up and successfully operating complicated solid waste separation technologies employed to recover materials and fuel. Thus, each participant in a resource recovery project is exposed to technical and economic risks. Although the Sanitary Fill Company design is probably workable, there is no operating experience with similar plant designs. Consequently, the actual plant capacity, system availability, product yields, emissions, capital costs (especially for start-up), operating and maintenance costs, and project schedule are major uncertainties.

These types of uncertainties have caused several other municipalities across the country to prefer various forms of "full-service" agreements for the design, construction, and operation of resource recovery plants. These agreements are with a single private entity who is responsible for all aspects of the project. The full-service contractor has generally been asked to assume the project risks which are under his reasonable control...especially those related to system performance, cost, and schedule. The contractors assume the risks by making long-term guarantees which are backed by the financial strengths and reputations of their corporations. Several large corporations have teams in place to design, build, and shakedown a facility, and are prepared and able to assume these risks.

There are also project risks which do not derive from the technology employed or the performance of the Contractor. These risks include inflation, changes in the prices of recovered energy and materials, changes in waste supply or composition, changes in public laws and regulations, and conditions of force majeure. These risks are probably beyond the Contractor's control and are likely candidates for risk sharing.

The City and Sanitary Fill Company have not yet resolved responsibility for managing each of the major project risks, or for assuming the consequences of their occurrence. With the City's risk posture and preferred relationship with a Contractor undefined, progress on the project will be impeded.

RECOMMENDATION: The City should consider protection against technical and economic risks outside of its control through either: (1) a full-service arrangement with Sanitary Fill Company and a financially strong and technically experienced partner; or (2) a cooperative agreement with Sanitary Fill Company to select a turnkey contractor to design, construct, start-up, and demonstrate commercial operation of the resource recovery plant, and to train Sanitary Fill Company operators for the post-demonstration phase of commercial operations. The City can save valuable time by entering into negotiations with Sanitary Fill Company instead of initiating a lengthy and arduous competitive procurement process.

* * *

CONCLUSION: Regardless of the approach used to procure and finance a resource recovery project, the City will be the ultimate guarantor of the financing and responsible for pay-back of debt if other participants default--

It is likely in San Francisco that a resource recovery project would be financed through some form of revenue bonds. Most revenue bond financings for resource recovery plants require a strong pledge by the participating municipality to pay disposal fees which are at least sufficient to cover bond debt service. Consequently, even though the City may pass this responsibility on to a private entity through a contractual arrangement, the ultimate burden to pay for the construction and financing of the recovery plant is likely to fall on the City's shoulders. Furthermore, regardless of contractual arrangements, it is the ultimate responsibility of the City to assure the safe and economic disposal of its solid wastes. Thus, the City must be cautious and rigorous in its approach to committing to a resource recovery project.

RECOMMENDATION: Before entering into negotiations for a resource recovery project, the City should: (1) determine risks it is willing to assume or share, and the risks which must be assumed by another party, and develop contractual principles which are consistent with this determination; (2) develop detailed performance requirements for the resource recovery system; (3) specify criteria for an acceptable team to design, build, and operate the system; (4) develop a scope of work for the implementation team; and (5) define its role in reviewing the performance of the system Contractor during design, construction, start-up, and commercial operation of the resource recovery facility.

* * *

In summary, Resource Systems' analyses lead toward conclusions that the proposed resource recovery project is, in concept, a feasible undertaking; that resultant net disposal costs can be competitive with landfilling; that environmental and resource conservation benefits are likely to accrue to the citizens of the Bay Area and the State of California; and that Sanitary Fill Company has performed responsibly in its efforts to initiate resource recovery for the City and County of San Francisco.

It is Resource Systems' overall recommendation that, subject to protecting the purposes of the environmental review process, the City proceed to implement the resource recovery concept proposed by Sanitary Fill Company. To carry-out this recommendation, the City must formulate a project implementation *process*, and must assemble a project team to direct and carry-out the process. The project implementation process should provide for public participation and for interface with source separation and other materials recycling activities. The project team should be able to have timely access to appropriate technical, financial, and legal resources from within the City and from outside organizations.

SUMMARY OF TECHNICAL FINDINGS

PERFORMANCE COMPARISONS

Resource Systems developed performance estimates for several alternative waste disposal systems. These included the Sanitary Fill Company concept as proposed, the Sanitary Fill Company concept modified to have one turbine generator instead of two, the Split System where waste is processed at the transfer station and shipped to remote boilers, and the Massburning Waterwall System where unprocessed waste is burned to produce steam. Resource Systems' estimates are based on test data from plants which process solid waste.

The performance projections are significantly different from those of the Sanitary Fill Company. The following synopsizes analyses performed by Resource Systems.

Unprocessible Waste

Some material (e.g. oversize bulky waste, pieces of metal, tires, etc.) which arrives at a resource recovery plant cannot be processed. The Sanitary Fill Company proposal makes no allowance for this unprocessible material. Unprocessibles usually amount to about 2 percent of the incoming waste, or over 9000 tons per year for the system proposed by Sanitary Fill Company. This material cannot be processed to produce electricity and will require landfilling or some other disposal method.

Fuel Recovery Rate

Resource Systems estimates that 60 percent of the incoming waste will be recovered as fuel. The Sanitary Fill Company's proposal predicts an 82 percent recovery rate. The substantially lower recovery rate predicted by Resource Systems is significant because less energy will be produced, energy revenues will be lower, and the amount of unrecovered material needing land disposal will be higher.

Metals Recovery

Resource Systems estimates that more magnetic metals will be recovered (7 percent) than Sanitary Fill Company predicts (4 percent). More recovered metals may increase project revenues and decrease net disposal costs.

Plant Processing Rejects

Resource Systems estimates that 26 percent of the incoming waste (glass, food waste, dirt, pieces of paper, etc.) will be rejected from the proposed fuel processing system. Sanitary Fill Company predicts a much lower reject rate of 13.5 percent. More rejects will decrease the amount of fuel produced and increase the amount of material that must be landfilled.

Ash Generation

Resource Systems' process and combustion calculations indicate that more ash will be left from the burning of the recovered fuel than predicted by Sanitary Fill Company. Increasing the ash content of the fuel from less than 4 percent to 12 percent increases the amount of ash requiring potentially expensive disposal from 13,000 to almost 35,000 tons per year.

Facility Downtime

Resource Systems estimates that the number and duration of unplanned outages in all or part of the plant will require taking 5 percent of the City's waste to a landfill. Sanitary Fill Company estimates that no outages would be long enough to force the use of alternate disposal methods. Resource Systems' downtime projection results in less product revenues, and more landfilling cost.

Summary

The differences in unprocessible waste, fuel recovery rate, metals recovery, plant processing rejects, ash generation, and downtime projections result in higher net operating costs than shown in the Sanitary Fill Company proposal. Table 1 shows a comparison of the system performance estimates, including estimates for the Split System and the Massburning Waterwall.

Table 1.

Summary of Systems Performance

Parameter \ System	Sanitary Fill Company System			Split System	Massburning Waterwall
	Sanitary Fill Company Estimates	Resource Systems' Estimates			
		As Proposed	With One Turbine Generator		
WASTE RECEIVED	492,750	492,750	492,750	492,750	492,750
SYSTEM AVAILABILITY	100%	96%	95%	95%	96%
OUTPUTS (Tons per year)					
Bypassed Waste	---	19,710	23,405	23,405	19,710
Unprocessibles	---	9,461	9,362	9,362	---
Processing Rejects	66,520	132,451	131,072	131,072	---
Magnetics	19,710	33,113	32,768	32,768	23,652
Non-Magnetics	2,465	1,892	1,872	1,872	---
FUEL	404,055	296,596	293,507	293,507	---
NET POWER SOLD(MillionKWH)	283	232	226	(14.6) *	259
STEAM (thousand pounds)	---	---	---	2.55×10^6	---
FURNACE ASH (Tons per year)	14,780	35,478	35,108	35,108	90,824

* Purchased Power

ENVIRONMENTAL EVALUATIONS

Air Pollution

The data available on air emissions from existing energy recovery plants is neither extensive nor precise. However, Resource Systems' analyses indicate that sulfur and nitrogen oxide emissions from the proposed Sanitary Fill Company system could be greater than the current limit of 250 pounds per day. Particulate emissions could also exceed the 250 pounds per day limit. A lower particulate emissions rate might be achieved if the proposed electrostatic precipitators limit emissions to less than 0.01 grams per standard cubic foot. This is a level of control achieved in very few plants world-wide.

Residue and Ash Disposal

Current California water quality regulations require that incinerator ash be handled as if it were a hazardous material. Raw unburned solid waste is classified as a nonhazardous material. Because hazardous wastes require special handling, disposal costs are much higher than for the landfilling of solid waste. A mass-burning waterwall system produces substantially more ash than does the system proposed by the Sanitary Fill Company. However, the Sanitary Fill Company system produces more total material for landfilling.

Noise and Water Pollution

Noise and water pollution emissions from the resource recovery systems evaluated should be minimal. Proper acoustical design, and routing of all liquid wastes to the sanitary sewer for disposal has proven to be adequate environmental protection at operating facilities.

ASSESSMENT OF LANDFILLING PROSPECTS

The assumption by the Sanitary Fill Company that the Ox Mountain site in San Mateo County would be the only landfill available for City waste after 1983 (other than the possible extension

of the contract with Mountain View) is questionable. Several other operating sites exist which are capable of receiving City waste beyond that date. In addition, the City has the alternative of purchasing and developing a new site. A preliminary investigation identified four locations where new city-owned sanitary landfills could be developed. Although the acquisition of new sanitary landfill sites is politically difficult, continued landfilling of San Francisco waste is possible.

SCHEDULE REVIEW

The Sanitary Fill Company predicts that they could begin full commercial operation of their system in 1983. As shown in Figure 4, Resource Systems estimates that the earliest commercial operating date is late 1984.

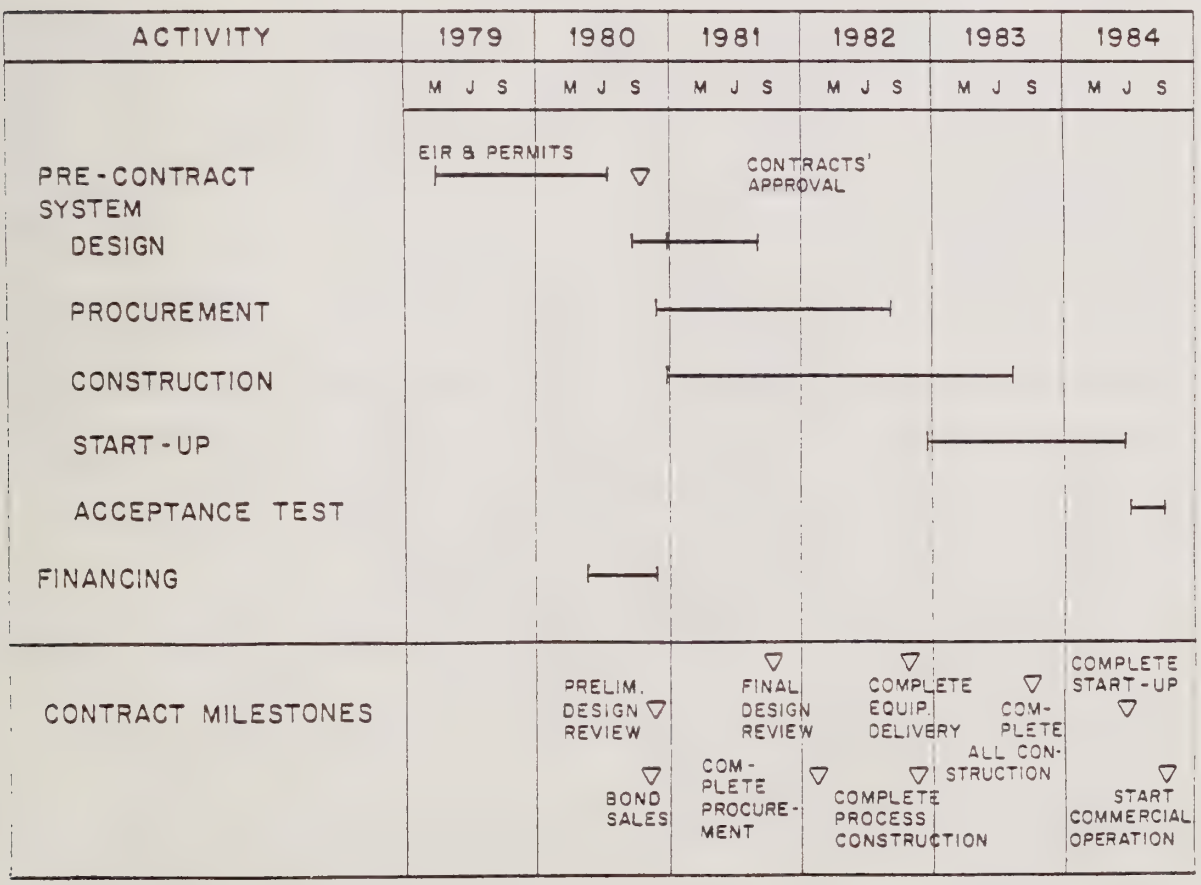


Figure 4.
Summary Schedule for Implementing the Sanitary Fill Company Concept.

The difference in schedules is primarily attributable to an allowance of close to 18 months for the completion of the environmental review process. Contracts cannot be signed and the project cannot be financed until the environmental review is completed. The construction and start-up times estimated by Sanitary Fill Company and Resource Systems are about the same. Resource Systems believes that a minimum of nine months will be needed after the system is built to accomodate the inevitable mechanical modifications needed to bring the plant up to capacity. Once routine processing at capacity has been achieved, an acceptance test can take place, and the plant should shift from start-up operations to routine solid waste processing in late 1984 or early 1985.

ECONOMIC REVIEW

The economic summary provided in Table 2 compares the net disposal costs of the Sanitary Fill Company concept, its minor variations including "splitting" the system and installing only one turbine generator, and a massburning waterwall system, to the probable range of 1984 landfill costs. The Sanitary Fill Company concept is expected to dispose of City waste for a net cost of $27 per ton in 1984. Approximately $4 per ton can be saved if the stand-by turbine generator is eliminated. The split system is expected to cost $29 per ton, and the massburning waterwall $18 per ton. If furnace ash must be handled as a hazardous material, net disposal costs would increase by $6 per ton for the proposed Sanitary Fill Company systems and $15 per ton for a massburning waterwall. Regardless of the final disposition of furnace ash, the Sanitary Fill Company concept is competitive with the expected 1984 sanitary landfill cost of $22 to $30 per ton.

Table 2.

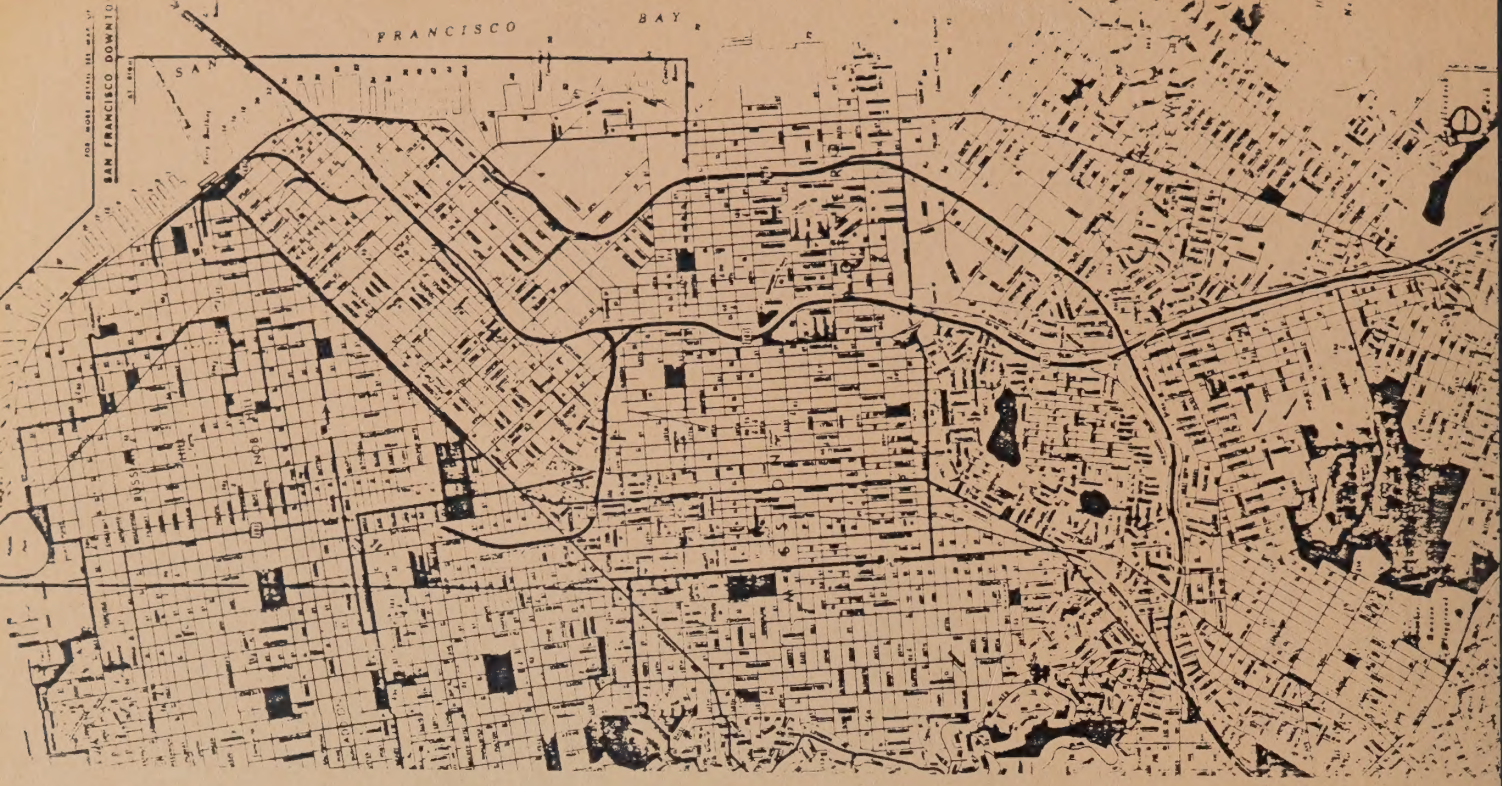
Resource Systems' Projection of Project Economics

1984 ($ Thousands)

	SANITARY FILL CO. DESIGN (2 Turbines)	SANITARY FILL CO. DESIGN (1 Turbine)	SPLIT SYSTEM	MASSBURNING WATERWALL
REVENUES				
Energy	$10,275	$10,009	$12,922	$11,471
Other	2,783	2,529	2,528	1,599
Total	$13,058	$12,538	$15,450	$13,070
EXPENSES				
O&M	$13,125	$13,162	$18,882	$ 9,551
Debt Service	13,358	10,852	10,846	12,469
Total	$26,483	$24,014	$29,728	$22,020
NET DISPOSAL COST				
Total	$13,425	$11,476	$14,278	$ 8,950
Per Ton	$27 ($33)*	$23 ($29)*	$29 ($35)*	$18 ($33)*

PROJECTED 1984 TOTAL LAND DISPOSAL COST = $22 - $30 per ton

*HIGHER AMOUNT (IN PARENTHESES) IS NET COST IF ASH MUST BE DISPOSED OF IN A HAZARDOUS WASTE LANDFILL



CSI RESOURCE SYSTEMS, INC.

55 Union Street • Boston, Massachusetts 02108 • Telephone (617) 742-5620